

ANCIENT LANDSLIDE DEPOSITS IN THE APPALACHIAN REGION

BELFRY LANDSLIDE AML RECLAMATION PROJECT¹

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AML reclamation projects in the Appalachian Region usually involve sites underlain by mine spoil deposits, subsidence of the overburden above underground mines and acid mine drainage. In addition, there are numerous sites where mining activities disturbed ancient landslide deposits known as colluvium, which are seldom identified in geologic or topographic maps due to their random location and presumed insignificance. These deposits are found as thick masses anywhere along the hollows of the region, except the ridges. Because of the nature of their original deposition, these deposits are marginally stable and can fail by slight changes to their geometry and/or hydrologic conditions.

The Belfry Landslide project is located within the community of Belfry, along the west flank of Pond Creek, in the northeast portion of Pike County, Kentucky. The Belfry Landslide occurred within a relatively narrow hill slope area (250 feet) underlain by unusually thick colluvial deposits laying directly below abandoned deep mine works. The slope disturbance was affecting several residences and roads located on three different levels. The slide measured horizontally about 480 feet from top to toe, with a vertical relief of 140 feet. A geotechnical exploration consisting of nine borings encountered colluvial deposit thicknesses ranging from 90 feet along the upper level to 15 feet near the toe of the slope failure. In view of the unusually thick soil deposits, slope inclinometer casing was installed in three of the borings to determine the depth of the failure plane. The slope inclinometer readings detected depths ranging from 30 feet in the upper and middle levels to 18 feet in the lower level, an indication that the landslide was fortunately not deep seated. This information was valuable in selecting the corrective measures.

Without information relative to the depth of the failure plane, the reclamation of large landslides underlain by thick soil deposits usually consist of performing a significant amount of earthwork, erecting retaining structures, or a combination of both methods. In this case, performing only earthwork would have required the excavation and disposal of a large volume of colluvial material and temporary relocation of some of the residences at an additional cost. The retaining structures would have consisted of a series of tie-back walls constructed by installing piling embedded into bedrock and supported laterally by rock anchors, and lagging installed between the piles.

¹ Paper was presented at the 2006 National Association of Abandoned Mine Land Programs 28th Annual Conference, September 25-27, 2006, Billings MT.

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After determining that drainage from the abandoned mine works in the coal seams above the site were the cause of the landslide, the Kentucky Division of Abandoned Mine Lands (DAML) designed a combination of corrective measures based on the geotechnical information. The design called for the dewatering of the deep mines, retaining structures constructed in a series to minimize the chance of mass movement and some earthwork to restore the house seat, access roads and stabilize the intermediate slopes.

A 260-foot long wall consisting of 36-inch drilled piers extending 45 feet into the ground and connected by a grade beam at the top was first constructed near the middle of the slide to protect the main access road and a residence. A similar but smaller wall was then constructed along the toe of the slide. A 15-foot high gabion wall was constructed at this location on top of the grade beam capping the drilled piers. Next, a 104-foot long and 8-foot high L-shape cantilever wall supported by rail steel anchored into bedrock was constructed south of the first wall to protect another residence. A fourth wall consisting of 36-inch diameter drilled piers extending 60 feet into the ground at 4-foot centers was constructed near the top of the second level to protect three residences. This wall was 200 feet long, included a 8-foot high cantilever section constructed on top of the drilled pier cap, and crushed stone backfill to reshape the slope above the residences. Two of these residences were further protected by constructing a 140-foot long wall consisting of 24-inch drilled piers installed at 6-foot centers and extending 40 feet into the ground. In this case the driller piers were capped by a 3-foot thick grade beam.

DAML constructed two additional walls along the lower portion of the slide to protect a county road and a residence and completed the reclamation in April 2006. The deep mine works located above the slide have been dewatered to prevent further saturation of the colluvial deposits. The system of retaining walls has stabilized the landslide successfully, providing protection to several residences and restoring or maintaining access to these and other residences. The Belfry Landslide project required the application of complex construction measures to stabilize a site underlain by unusual subsurface conditions.